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Investigative Report
Intermountain Region

June 9, 1934.

REPORT OF THE

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION

1933-1934

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R - INT
Investigative Program

June 9, 1934

INTRODUCTION

The work of the Intermountain Forest and Range Experiment Station since the date of the last report represents a grand effort to squeeze three or more years of work into a 12-month period. To an already overcrowded schedule of each regular employee endeavoring to carry on essential field work and analysis of data, was added the very heavy construction program brought on by ECW and Impnira, advisory work to the administrative organization in ECW, Resnira and the ECW research program, CWA data compilation and development work, the lumber code, leave for attending school and other purposes and details to Washington, totalling 27-man months time of regular employees, and more than usual public contact work. In spite of every effort to secure additional help to handle both improvements and research work under the emergency funds, it has been no small task for the regular personnel to develop plans, and instruct and supervise the new personnel in details of the work -- responsibilities which could not be delegated. In addition, there has been the unsatisfactory situation resulting from uncertainty of when, how much, and for what period the various funds would be available, plus the urge, all the time, to give the earliest and greatest possible relief to unemployed. The increased complications in fiscal procedure and other restrictions incident to using

the money allotted has served further to add to the confusion and delay. Under all of this pressure the morale of the regular personnel remained high in spite of unjust inequalities in salary due to the restrictive personnel policy.

But in spite of all of these difficulties excellent progress has been made in pushing forward to conclusion many phases of the research projects and in developing the physical plant of the Station. With few exceptions no new phases of work have been undertaken. Effort is being focused on bringing to publication stage every possible phase of the going work. Compilation, analysis and writing is being undertaken on a wholesale scale. For that reason few "new results" are available for insertion in this report, few of them having, as yet, been carried to that stage. Instead every such job is being pointed toward completion by the end of the calendar year.

No regular investigative committee meeting was held this year. Instead, approximately a day and a half in April was devoted to an informal discussion with the members of the regional office of the work the station proposes to do during the ensuing year.

The material in this report is segregated under four main headings as follows;

1. Personnel.
2. Progress and plans in projects.
3. Progress and plans in publications.
4. Progress and plans in physical development of Station plant.

PERSONNEL

The regular and emergency personnel on the various projects are as follows:

Overhead

Regular

C. L. Forsling, Director
W. E. Mann, Chief Clerk
Marguerite A. Israelson, Clerk
Blanche Hoxsie, Asst. Clerk

Emergency

Stephen F. Tillman, Associate Editor
Byron F. Thurmond, Surveyor-Draftsman
Herbert Burrell, Principal Clerk
Mary A. Monson, Assistant Clerk
H. J. Blake, Construction Foreman

Forest Management

Regular

C. A. Connaughton, Junior Forester, in charge
E. L. Mowat, Junior Forester

Emergency

Technicians (P-1)

T. E. Maki
H. S. Hinkley
W. B. Read

Estimators

T. C. Pender
C. A. Fawcett

Assistant to Technicians

L. H. Carlson
Norman Nelson
R. H. Hall
_____vacant

Range Management

a. Summer Range (Wasatch Plateau--Great Basin Branch)

Regular

Raymond Price, J.R.E., acting in charge

Emergency

Special

Dr. E. C. McCarty
Dr. Sylvia M. Griswold

Technicians (J.R.E.)

Dr. D. I. Rasmussen
James A. Hockday
A. J. Lindsey
_____vacant

Assistant to Technicians

Leslie H. Albee
Basil Crane

Assistant Clerk

_____vacant

b. Desert Shrub Range

Regular

Dr. George Stewart, Senior Forest Ecologist
Selar S. Hutchings, Junior Range examiner

Emergency

Technicians (J.R.E.).

Ben R. Stahmann
Wesley Keller
_____vacant

Assistant to Technicians

William Stanton
Jos. R. Christiansen
Charles Menzies
John McGuire

Associate Ecologists

Dr. W. P. Cottam
Dr. Vernon A. Young

c. Sagebrush-Wheatgrass Range

Regular

Dr. George Stewart, Senior Forest Ecologist
G. D. Pickford, Assistant Silviculturist

Emergency

Technicians (J.R.E.)

Joseph F. Pechanec
Alvin V. Steed

Assistant to Technicians

Sylvan D. Warner
Talmage Nelson
Victor A. Surface

Erosion-Streamflow Investigations

a. Bunchgrass-Granitic Soil, Idaho

Regular

George W. Craddock, Jr., Associate Range Examiner
Kenneth Pearse, Junior Range Examiner

Emergency

Conservationist

Verne M. Stambaugh

Technicians (J.R.E.)

Kenneth M. Daniels
Paul E. Lemmon

Assistant to Technicians

Maurice W. March
_____vacant

Collaborators

Liter E. Spence, (Univ. of Idaho)

b. Great Basin

Regular

Milo H. Deming, Assistant Range Examiner

Emergency

Conservationist

Reed W. Bailey

Technicians (J.R.E.)

Wallace M. Johnson
A. R. Croft (E.C.W.)

Assistant to Technician

Herbert C. Fletcher

Civil Works Administration

Twenty-five C.W.A. workers consisting of one trained forester, two engineers and two with general biological training and 20 computers were employed by the Station from late in November until late in April. With a Technician (J.R.E.) in charge, this group did very effective work in bringing all back and current compilation in all projects up-to-date. The system of supervision and double checking used reduced errors in work of such inexperienced employees to a minimum.

FOREST MANAGEMENT (Silvical Research)

Methods of Cutting Ponderosa Pine

Forest management investigations are confined largely to a study of methods of cutting ponderosa pine. This major project is supplemented to some extent with a few closely associated sub-projects that have been undertaken to satisfy local questions and demands. The following progress has been made in 1933:

1. Methods of cutting ponderosa pine sample plots.

Seven 10-acre permanent sample plots were established on the experimental forest. The following methods of cutting were included: (1) "Economic selection" such as the local lumbermen seem to favor at present; (2) 14-inch diameter limit; (3) 24-inch diameter limit; (4) Seed tree; and (5) Regular forest service method with the marking based on Dunning's tree classification. Special studies of reproduction, utilization and slash disposal were made on these plots.

2. The application of permanent sample plot growth data to cut-over land.

The Station is undertaking to make the most effective use of a large amount of local sample plot information by incorporating it with data gathered from cut-over cruises throughout Region 4. All sample plot data and a large number of extensive cut-over cruises have been compiled.

3. Growth in virgin ponderosa pine stands.

An article, showing that significant net growth occurs in virgin ponderosa pine stands, has been accepted by the Journal of Forestry.

4. Influence of forest cover on storage and rate of melting of snow.

This study of the influence of different crown covers, which might result from various cutting methods of ponderosa pine, was brought to a close in 1933. A very brief preliminary summary showing a high rate of interception of snow by high forest canopies has been published. Further analysis is progressing.

5. Fire damage in the ponderosa pine type.

This study was undertaken as a matter of expediency following the disastrous fire season of 1931. All plots and reproduction transects were examined in 1933, and considerable time was devoted to the analysis of an extensive fire damage cruise. Significant facts regarding the extent of depletion of all forest values are forthcoming from this investigation.

6. Timber Survey and Mapping.

A topographic map and timber survey were made of 2,700 acres within the experimental forest. All exterior boundaries of the forest were traversed and marked.

7. Reproduction and Plant Succession.

This study has been conducted under an informal cooperative

arrangement with the University of Idaho. Lack of subsequent reproduction following cutting is pointed out and emphasized in a report submitted by that institution.

8. Cooperation with Region 4.

Wood cylinder and duff hygrometer fire hazard measurements for 1933 have been analyzed and incorporated into charts to show the use of these data in predicting fire hazard for distribution within the region.

Plans for 1934

1. Precedence is to be given to the compilation and analysis of existing data and preparation of reports on the following subjects:

   a. Intensive cut-over sample plots and extensive cut-over cruises.

   b. Special methods of cutting and utilization studies.

   c. Fire damage study.

   d. Relation of crown cover to storage and rate of melting of snow.

   e. Timber survey, maps, and management plan for the experimental forest.

2. Approximately 50 temporary ponderosa pine yield plots are to be established and the derived data submitted to the Pacific Northwest Experiment Station for compilation. These plots complete the Intermountain Station's share in the interregional pine yield study.

3. Sample marking, seed production and other data necessary for the management and demonstration of the experimental forest will be obtained.

4. Reproduction transect re-examination and other miscellaneous work will be done on the method of cutting plots established in 1933.

5. Permanent fire damage plots and transects will be re-examined.

6. At the request of Region 4, this Station will supervise the compilation and interpretation of all existing selective logging data that is applicable to this region. This study will be prepared in the form of an administrative report and used in modifying the existing cutting practices of the region.

7. Several urgent short time projects are contemplated under authorization received from the Hire and ECW research programs. The most important of these are as follows:

a. Reforestation

(1) Thirty-five thousand ponderosa pine transplants have been planted in cooperation with Region 4, on the 1931 Boise Basin burn. The Station will undertake studies of growth, survival and causes of loss, especially during the first season.

(2) In view of prospective drought conditions for 1934, a study of seasonal depletion of the moisture content of evergreen leaves is timely and will be coordinated with the plantation study.

This phase of the problem has physiological significance as well as attempting to anticipate and explain the cause of "explosive conditions" which seem to exist in ponderosa pine in years of extreme fire hazard.

b. Timber Stand Improvement - A study of the possibilities and necessities of thinning ponderosa pine is anticipated. Preliminary procedure will be designed to ascertain the extent of ponderosa pine stagnation and whether this species is able to express early dominance without the aid of thinning. The most desirable spacing to maintain in evenaged groups of immature "black jack" pine which would be probably thinned coincident with lumbering operations will also be investigated.

c. Timber Surveys - Additional timber land both within and adjacent to the experimental forest will be mapped and cruised in order that the inventory of the local working circle can be completed. It is desired to prepare a local volume table based on "tree class" to accompany this cruise.

d. Insect Control - Losses due to bark beetle attacks are to be brought to a minimum within the experimental forest by means of intensively applied control measures.

RANGE MANAGEMENT INVESTIGATIONS

I. Summer Range - Wasatch Plateau (Great Basin Branch)

Field work on this project during 1933 was confined to that necessary for maintaining continuity of records in established projects. No new work was contemplated. The drastic cut in regular research appropriations, which necessitated laying off all temporary personnel at one time, and the detail of Assistant Range Examiner E. W. Nelson to ECW and his subsequent leave of absence, greatly hampered progress. However, by concentrating on certain phases of the work during the early season while the two regular field assistants were available, and later using the help of two selected CCC men, practically all of the essential records were obtained. The status, progress and plans for this project will be discussed by projects or lines of work:

1. The Effect of Climate on Plant Growth

Necessary recurrent field measurements were made. E. W. Nelson was engaged in analyzing the data which had been collected for a number of years, some of it extending back as far as 1913. His ECW activities and leave of absence have delayed progress in this analysis. Since Nelson has definitely resigned, the project will now be turned over to someone else as soon as arrangements can be made to do so. It is planned to have the analysis and report completed this year. Records essential to supplying a basis for other projects constitute all the field work in this project for the coming season.

2. Natural Revegetation as a Means of Improvement and Maintenance of the Range

Seventy-six quadrats and 71 major plots, some of which were established back as far as 1914 for the purpose of studying the rate of natural revegetation under various conditions of plant depletion, have been remapped periodically up to the present time. Compilation has been brought up-to-date. It is planned to recheck and remap all of these so that there will be a complete record for 1933 or 1934. Analysis of the data and preparation of the report is planned for this year.

3. The Role of Seeding Habits in Range Plants in Natural Revegetation

For a number of years Dr. Sylvia M. Griswold has been engaged in the study of the germination under 17 conditions, of 55 of the important range plants on the Wasatch Plateau, to determine the conditions influencing germination of these plants in relation to their reestablishment by artificial or natural means upon the range. Dr. Griswold will spend the summer in the Ogden office to complete her manuscript.

4. The Degree of Utilization as a Factor in Range Management

Field work in this subproject was completed in 1932 and has been summarized for analysis. Nira help will be used to complete the analysis of results during 1934.

5. The Influence of Season, Frequency and Degree of Harvesting on The Productivity and Vigor of Range Vegetation

This subproject includes three phases, namely: (a) the empirical clipping phase, including both herbaceous and shrub plants, (b) the grazing phase, and (c) the plant nutrition phase.

(a) Empirical clipping phase.

Preliminary analyses have been made of the data collected from the clippings of two grasses and one weed species carried on under 16 systems of harvesting over the period 1923 to 1929, inclusive. Data are also being summarized on the results of clipping 2 browse species under 4 methods of treatment over a period of 8 years. This work has been assigned to the Nira Junior Technician who is spending his full time in the office with the view of completing analyses and preparation of a manuscript this year.

(b) Grazing Phase.

Results obtained with 6 systems of clipping, carried on over the period 1923 to 1930 inclusive, are being analyzed for the completion of a report this year. This phase is being handled by Dr. D. I. Rasmussen.

(c) Nutrition Phase.

The nutrition phase is being conducted by Dr. E. C. McCarty of Riverside Junior College, employed by the Station during the field season to collect his data and samples, make clippings, etc. During the winter he makes chemical analyses of the samples at Riverside Junior College. This is the third and last year for study of a series of plots.

The subproject involves an attempt to determine the influence of different seasons and frequency of harvesting on the vegetation as indicated by the annual food march or carbohydrate index. For a long time, a method has been sought for measuring the influence of any given system of treatment on plant growth. The chief method used in

the past consisted of clipping and weighing the forage produced and of determining plant changes or plant succession on the growth. Both of these methods are indefinite and cumbersome. The present study is expected to develop a method involving the carbohydrate index which will quite accurately determine the growth as well as the cumulative influence of a given system of treatment for grazing upon range vegetation. Consequently, this may be regarded as a basic or fundamental piece of research that is creating a much better understanding of plant growth processes in relation to range management. Some of the findings to date may be of interest. In a previous report it was pointed out that the carbohydrate index of Bromus polyanthus varied from as low as 3.35 at the time the ground was bare of snow in the spring, to 6.72 at the beginning of the blooming stage early in July. Subsequent to blooming, the index practically doubled, reaching 12.87 to 14.43 at which level it remained until late September when all foliage development ceased and the index rose further to 18.29 to 18.6 where it remained through the month of October when sampling was discontinued. This showed the difference between 18.29 in October to 3.35 in May, which was unaccounted for. Sampling was continued at monthly intervals through the winter of 1932-1933 until April, after which samples were taken at approximately 10-day intervals. From these samples it is evident that there is a slight decline of 14.31 to 16.8 in the carbohydrate index from late October until active growth starts the following spring. This decline is believed due to respiration. The

index drops sharply when growth starts in the spring, this rapid decline undoubtedly being caused by the "drawing upon" of the stored carbohydrate to support the increased growth processes. A very interesting point brought out is that growth started practically six weeks prior to the recession of the snow. In this particular case growth started under 34 inches of snow and increased this activity in spite of the fact that the snow depth increased to 54 inches over a period of a month after active spring growth started. The soil under the snow was free from frost, probably due in part to conduction below the frost level, in part to water percolating down from the snow cover, and in part to the liberation of heat due to subsequent freezing of the water near the soil level.

Compilation and analysis of results in this project have been kept up-to-date and it is expected that the report will be in manuscript form shortly after data from the samples collected in 1934, which will be analyzed during the winter of 1934-1935, are available.

II. Artificial Reseeding

Practically no experimentd artificial reseeding trials have been initiated on summer range since 1931. Subsequent efforts have been devoted largely to recording observations of previous sowings, which will be continued through 1934. Summarization of tests made with crested wheatgrass indicate that this species is quite adaptable to artificial reseeding of range in the sagebrush, bunchgrass, and oakbrush zones, (spring-fall grazing types).

Five acres of crested wheatgrass were sown on abandoned cultivated land at the U. S. Sheep Experiment Station in May, 1933 at the close of a cold, wet period. The seed was drilled with an ordinary grain drill at a depth of about 1½ inches and at a rate of 10 to 15 pounds to the acre. On half of the area a seed bed was carefully prepared by disking. The remainder of the area was seeded without seedbed preparation.

The driest summer, fall and winter on record followed this sowing, precipitation from May, 1933 to March, 1934 inclusive, being only 4.26 inches, or 2.52 inches below average. The seed germinated in a thick stand, but by July, 1933 growth had ceased entirely and the small plants were dried up.

No growth was in evidence in the early spring of 1934. However, growth of crested wheatgrass started immediately after a light rain in April, and, without additional precipitation, by the middle of May the last year's seedlings were firmly established and stooling out in a successful stand. On June 1 many flower stalks were in evidence. The stand is no better on the prepared seedbed than on the firmer unprepared part of the area.

These results indicate that there should be no question of getting a successful stand of crested wheatgrass with this method in a normal year under conditions found at the U. S. Sheep Experiment Station. The grass should prove to be valuable in reclaiming thousands of abandoned dry farming fields on lands of similar character.

Further experiments will be conducted at the Sheep Experiment Station to ascertain whether successful stands of crested wheatgrass may be obtained by broadcasting the seed on sagebrush land and trampling in of the same by sheep.

III. Management Sagebrush-Wheatgrass Range

The working plan of the Sheep Station was modified in 1933 and in lieu of the study of season of use, the present phase of which is completed, there was substituted two experimental systems of management having as their objective, the improvement of depleted range and maintenance of range in fair condition. Past studies have shown that improvement and maintenance of spring-fall range depends upon the treatment given during the spring grazing period, which is also the season of plant growth. One of the experimental systems involves dividing the spring grazing season into three periods and so grazing the range that each subdivision of the range will be grazed the first period only in one year, the second period only in another year, the third period only in the third year and deferring grazing until the fall season every fourth year. The second system involves dividing the spring season into four equal periods and grazing any particular range unit the first period only in one year, in the second period in a succeeding year, and so on through every 4-year period, without totally deferring grazing until after seed maturity in any year. By the use of four paddocks in each unit the tests will be run in quadruplicate. Another phase involves the study in duplicate paddocks of three degrees of intensity of grazing, without alternated or deferred grazing.

The plan calls for detailed utilization estimates and measurements at the close of each spring grazing period, at the close of the

spring grazing season, and preceding and following the fall grazing season. Utilization estimates and measurements are being further supplemented by weighing ewes both in and out of the paddocks, and recording the average gain or loss during the spring grazing period for each paddock.

All transect sample plots were reestimated and all protected quadrats charted. A start was made in establishing and mapping browse plots in paddocks and enclosures to study sagebrush invasion.

The seasonal rainfall (Oct. 1, 1932 to Sept. 30, 1933) was the third lowest on record at the Station, being 1.53 inches below normal. Much of the deficiancy occurred after May 1. Notwithstanding a cold, delayed spring and an extended drought after May, the paddock which was grazed earliest in the rotational system made a regrowth of 22.4 percent from the end of the grazing in the paddock (May 17) to the end of the spring grazing season (June 22). It was estimated that 70 percent of the total forage produced in the paddock was left available for fall grazing.

The present cycle of deficient rainfall has prevented much needed improvement on spring-fall ranges in this locality, even though the areas were completely protected from livestock. Basal areas of perennial grasses on four protected quadrats established since 1923, have increased but a fraction of a percent during a 10-year period of protection. Curiously, the crown spread of sagebrush and other unpalatable browse has increased thirteen times on these quadrats.

Influence of Burning on the Range

Approximately 50 percent of four sections of sagebrush-wheatgrass range on state lands north of St. Anthony, Idaho was burned during the summer of 1933 in cooperation with the Fremont Woolgrowers' Association, preparatory to determining the induced succession of bunchgrasses following burning of sagebrush.

Plans for 1934

The analysis of data secured from 10 years study of season and intensity of grazing and of climate on range management is nearing completion.

The spring-fall portion of results obtained from a survey of range conditions on the Public Domain in 1932 is being prepared.

A short manuscript on the effect of conservative versus heavy and uncontrolled grazing, is expected from the analysis of detailed range survey data on the U. S. Sheep Station reserve and on adjoining open range.

An article for a journal, dealing with new research methods, is contemplated.

A preliminary report on the effect of controlled burning of sagebrush on herbaceous vegetation will be drafted, as soon as data can be collected and analysed on an area burned in 1933.

A detailed range reconnaissance will be made of the entire station reserve, including also four or more sections of open privately owned range lands. The data will serve as a recheck on the 1925 survey, a comparison of moderate versus heavy spring utilization, and as a basis for future range studies.

Systems of grazing as initiated in 1933 will be continued with slight modifications.

Routine work, including mapping of quadrats and browse plots, estimating forage on transect plots, etc., will be continued.

A grass clipping study to determine the period and season most susceptible to injury by grazing, will be initiated.

Phenological and climatological measurements will be continued.

A comprehensive recheck of palatability of forage plants will be started.

A complete recheck of all transect, quadrats, browse and species plots burned in 1933 on the area north of St. Anthony will be made. Fences will be erected on seven 1-acre plots and two major plots to determine the effect of protection and controlled grazing on the herbaceous vegetation of burned sagebrush range.

IV. Management Desert Shrub Range

Since the Desert Shrub project is new, no longtime accumulations of data are available. Most of the work done to date will supply a base upon which to build all future investigations. Some of these data are quite significant and should afford some worth while publications.

1. Enclosures and Grazed Plots

Three 4-acre enclosures and a similar number of grazed plots established in June, 1932, have visible improvement in desert shrub vegetation. On one in which ricegrass, Oryzopsis hymenoides, was important in the species composition, there was a very apparent improvement over the grazed range. The major part of this difference can no doubt be attributed to the accumulation of the current year's growth. It is rather surprising, however, that the amount of growth would be so marked during a year of drought.

2. Range Survey

During the summer of 1933 a range survey was made of the newly enclosed desert range and 23 sections of similar adjacent range. These data now compiled, gives an inventory of species and plant cover that will form a basis for all future comparisons as to the effect of controlled and uncontrolled grazing. This influence should be accurately observable with such an excellent base from which to begin.

3. Palatability and Utilization

Observations were made during the winter season to determine the palatability of the major constituent species under winter grazing conditions. The percentages of the various species taken by the sheep

were carefully estimated and recorded. Palatability and utilization of the various forage plants are definitely influenced by species composition, moisture, and season grazed. The palatability is also different for individual herds.

4. Herd Histories

Activities of each herd on the desert experimental range were observed during the winter of 1933-34. The following data were recorded:

A. Areas and types grazed.

B. Bedgrounds and number of nights bedded on each ground .

C. Route of yearly travel.

(a) Location of lambing range.

(b) " " summer range.

(c) " " fall range.

(d) Approximate length of use of each.

D. Method of Herding.

E. Daily log of the movement of each herd.

F. Kind and amount of supplemental feeding.

G. Sheep.

(a) Breed of ewes.

(b) Age classes.

(c) Date of bucking.

(d) Breed of rams.

(e) Ratio of rams and ewes.

5. Desert Transect

A vegetation transect 21 miles in length with elevation varying from 5,100 to 9,400 feet, was made across a desert valley from mountain ledges on one side to a timber covered peak on the opposite side. Practically all types of desert plants were crossed and in addition a mountain brush zone and a small timber area.

Vegetative and topographic changes were mapped in detail in a strip 200 feet wide and data taken on plots at 132-foot intervals were recorded as follows: species found and their density, the number of mature plants and seedlings of the major shrub species, ring counts on the important shrub plants to determine the average age. In addition trenches were dug on each of the major plant types from which soil samples were taken, soil profiles mapped and the root systems of the main species carefully plotted. The above data show the extent to which the various plant types follow changes in soil and topography. As soon as the soil analytical work is finished, careful and complete correlations can be drawn.

6. Plant and Soil Relationships

Observations were made and soil samples collected from trenches dug across the boundaries of sharp changes in two or three major plant types and in the interior of the larger more or less pure vegetative "islands." Distinct differences in soil depth and stratification were found. Preliminary electric bridge readings in the field showed differences in soil alkali content from type to type of plant cover and from one layer to another in soil formation. This knowledge of the soil will

help to explain the distribution of vegetative types and will aid in determining the sort of revegetation that may be expected under conservative grazing management and reseeding, if that proves feasible.

7. A New Survey Plot Method

A new plot method has been devised for estimating plant densities and composition. Circular plots 100 or 200 square feet in area are marked off and density of each species then estimated by determining the number of square feet of complete cover which occurs within the plot. The density is then recorded directly in square feet per hundred. The above method is especially suitable for range survey of shrub, grass and weed vegetation. Plots are taken at random by mechanically dividing the areas to be studied. Enough plots are taken in each type to give a representative sample. This method lends itself readily to application in the field and the training time required to teach new men is reduced more than half.

8. Nutrition Study

The Utah State Agricultural Experiment Station started some tests under informal cooperation with the Intermountain Station, to determine the value of supplemental feeding of cottonseed cake and corn to sheep and the deficiencies of mineral in the more important plants on winter range. This work will be carried with avoidance of conflict with the range management studies of the Forest Service.

9. Manuscripts for publication

The work done in 1933 and previous years afford sufficient data for several manuscripts. Among these are plant sap data obtained

in cooperation with the late Dr. J. Arthur Harris. Dr. Vernon A. Young, who worked with Dr. Harris several seasons has been engaged for the summer of 1934 to assist Dr. Stewart on this project. The transects and other ecological data afford sufficient information for an article on forage types and successional trends on desert range, and one on the relative quantity and quality of forage produced on different desert shrub associations. The revised method of making range surveys also warrants a publication on that subject. The data obtained in the 1932 survey on conditions on the public domain justifies a publication on influence of past grazing on present conditions and future management of this range.

Plans for 1934

The plans for 1934 are briefly summarized as follows:

1. Analyze data and prepare manuscripts on all completed projects.

2. Concentrate and develop experimental work at the Desert Range Branch Experimental area and prepare plans for system of experimental grazing.

3. Establish complete climatological station at headquarters.

4. Continue plant growth and plant development records.

5. Continue palatability and utilization studies.

6. Continue animal nutrition studies in cooperation with the Utah State Agricultural Experiment Station.

7. Set up experimental enclosures on the experimental range.

8. Make a vegetative survey in Nevada of the Southern Pacific right-of-way which has been protected from grazing for 30-40 years to obtain additional information on potential productivity and present depletion of various desert range types.

9. Make frequency studies of desert species similar to Raunkier's method in an attempt to develop normal distribution laws for range species for use as a base in plant succession studies.

EROSION-STREAMFLOW INVESTIGATIONS

Bunchgrass Granitic Soils, Idaho

The solution of the erosion-streamflow and range problem on the Boise River watershed, on the basis of preliminary investigations, is largely a matter of restoring on critical areas, a vegetative cover that will arrest erosion of the highly erosive granitic soils and produce desirable conditions in run-off, and at the same time provide reasonable grazing of the range. The rehabilitation of the cover is complicated by the fact that it must proceed from various stages of plant and soil depletion resultant of past erosion. The problem has been attacked from various angles. Progress during the year 1933 was made in measuring the precipitation factor, studying the influence of cover on surficial run-off and erosion, and studying individual plant species to determine the value of their root systems for binding the soil. Although inadequate data were gathered to warrant publication of any particular part of the work, some of the results appear to have special significance.

Snow Surveys

Three snow courses were established on representative areas in 1930 to supplement ordinary precipitation records. Measurements have been taken for four years in cooperation with the Boise River Board of Control. The results of these surveys indicate a close correlation between winter precipitation and streamflow, and are valuable in predicting streamflow several months in advance. A summary of the measurements made on two of the most representative courses and pertinent streamflow data are given in the following table:

Table. Relation of the annual discharge of Boise River and water content of snow on the watershed prior to melting during the period 1930-1933 inclusive.

Periods	Boise River Discharge		Snow Water Content	
	Acre Feet	Departures From Normal (Percent)	Inches	Departures From Normal (Percent)
31 Year Normal	2,160,000		44.2*	
1930	1,341,000	-38	28.0	-37
1931	902,000	-54	21.5	-51
1932	1,954,000	-11	38.5	-13
1933	1,607,000	-26	32.4	-27
4 Year Average	1,451,000	-33	29.6	-33

* Normal snow water content was derived as follows: 29.6 ± .67

These data show an exceptionally close correlation between departures from normal in streamflow and in snow water content. They indicate that precipitation is by far the most important factor influencing total stream discharge. (The results do not touch upon the character or period of run-off which may be influenced by various factors.)

Applicability of the snow survey data is well illustrated in what occurred in 1933. The water-users in Boise Valley, basing their assumptions upon general experience, believed that there would be insufficient run-off to fill the two reservoirs on the Project (Arrowrock and Deer Flat). Since Deer Flat Reservoir is filled by diversion from Arrowrock, it is necessary first to fill Deer Flat and then store in Arrowrock. If there is insufficient water, both reservoirs cannot

be filled, but irrigation requirements demand that consideration be given to equal filling of both reservoirs in order that water may be equitably distributed later in the season. Early in the season the water-users, believing there would be insufficient streamflow to fill both reservoirs, pressed for filling Arrowrock only. The Board of Control was able so accurately to predict the volume of flow on the basis of snow measurements, that both reservoirs were filled, whereas the assumptions based on general experience of the water-users would have resulted in only partially filling one of the reservoirs and subsequently wasting a lot of the water that otherwise could have been stored.

Auxiliary Rain Gauges

A number of additional rain gauges were established to obtain more comprehensive information on summer precipitation on the Boise River watershed. This is part of a program to obtain accurate information on the influence of amount and character of summer rainfall on streamflow and erosion. Heretofore, records have been obtained on only widely separated portions of the watershed. These rain gauges were established in cooperation with the fire organization of the Boise National Forest and cooperating ranchers and other occupants of the region.

Surficial Run-off and Erosion

One of the essential features of the study is to measure the influence of different kinds, degree and character of herbaceous vegetation on surficial run-off and erosion for the different conditions of soil, slope, etc., as a basis for determining the kind and quantity of cover necessary to control erosion and run-off. High cost of permanent

installations for each of the many conditions involved, and the uncertainty of occurrence of natural rainfall to afford adequate results, make such a study difficult. To meet this situation a portable apparatus to artificially create rainfall conditions is well under development. This provides for applying water to resemble rainfall on 5-milacre plots equipped with gauges to measure run-off and removal of sediment for different intensities of rainfall. A summary of the results showing the average values derived from quadruplicate tests are given in the following table:

Table. Quantity of silt in terms of tons per acre, eroded from temporary 5 milacre plots on three different plant types, under two conditions of soil and two intensities of artificial rainfall.

Rainfall (Approx. 2.00 Inches)	Low Intensity (.03 Inches per Minute)		High Intensity (.065 Inches per Minute	
Soil	Untrampled	Trampled	Untrampled	Trampled
Annual Weed Type (.05 Density)	.2609	.3531	1.3906	4.4172
Cheatgrass Type (.15 Density)	.1175	.1375	.5516	4.0088
Bunchgrass Type (.45 Density)	.1313	----*	.1250	.2094

*This series of four tests was omitted due to lack of water and a shortage of personnel.

Although results to date are not considered conclusive, information thus far obtained indicate rather significant differences with respect to the effectiveness of each of three plant types in controlling erosion. When subjected to low intensities of rainfall, all three are

reasonably effective, although the annual weed cover is the least valuable. When subjected to rainfall of intensities comparable to a "cloud burst", however, the effectiveness is rather variable. Under untrampled soil conditions, 10 times more erosion occurred on the annual weed and 4 times more occurred on cheatgrass areas as compared to that of bunchgrass areas. Under trampled soil conditions, as compared to untrampled, with high intensity of rainfall, erosion more than trebled on the annual weed type, increased seven-fold on the cheatgrass type, but was less than doubled on the bunchgrass areas, and 21 times more erosion occurred on the annual weed type and 19 times more on cheatgrass as compared to bunchgrass types.

During the 1934 field season, it is planned to operate a battery of two of these portable units in testing additional range conditions. A tentative schedule involving 180 quadruplicate test runs for each condition studied has been outlined. These data will be compiled and analyzed and reported on in the fall of 1934.

Root Studies

The character of the root system of the vegetation is believed to play an important part in binding the soil against erosion. Excavation and examination to determine the character of root systems was initiated in 1932 and continued through 1933. Thus far from 3 to 5 typical root systems of over 25 herbaceous species on both north and south slopes have been excavated and sketched to scale. The results of these studies, although they cannot be expressed adequately in quantitative terms, qualitatively appear to be of considerable

significance. They show that the root systems of most of the plants now occupying the more depleted and eroded south slopes are of the weak, single top root class, or in the case of cheatgrass a shallow, fibrous root system poorly adapted to hold the soil in place. On the other hand, the principal perennial grasses and weeds found on the less eroded north slopes are characterized by root systems that are heavily branched through the surface six inches of the soil. It is apparent that one of the reasons for the more serious erosion in the annual weed and cheatgrass plant types as compared to the bunchgrass type is that the root systems of the individual plants of the annual plant types are less effective than bunchgrass and many of its associates for holding the soil in place.

More complete information is needed with respect to the root habits of the various species involved. Accordingly it is planned to continue the root studies during the 1934 season. Sufficient data should be available at the close of the 1934 season for a fairly comprehensive report.

Quadrat and Plot Studies

Closely associated with other phases of this study is the determination of the rate and extent to which natural revegetation takes place, and the extent to which erosion is controlled thereby, on non-grazed areas as compared to grazed areas. A large number of quadrats and larger plots have been established in this phase of the study during the past several years. It is planned to remeasure all of these plots during the 1934 season and prepare a report of the significant trends that have been developed under the several conditions.

Watershed Installations

The plan of the project provides for the selection of several small comparable complete drainages or miniature watersheds, each of which will be subjected to a different intensity of use to determine the influence of grazing, trampling and plant cover on erosion, surficial run-off and sub-surface drainage. These are to be equipped with devices for measuring precipitation run-off and removal of sediment by erosion. The results on the areas will be compared for a number of years before the plant cover is modified, after which each will be subjected to a different intensity of grazing. Three such watersheds, approximately 10 acres each in area, were tentatively selected for this purpose in 1933 in Bannock Creek near the Boise Basin Branch headquarters. These will be subjected to further investigations as to geologic conditions, plant cover and topography prior to installing the necessary elaborate equipment required. Nira funds are available for installing the equipment.

Great Basin

Subproject 1: A study of the effect of plant cover and grazing on surface run-off and erosion, on limestone-shale clay soils of Wasatch Plateau.

This is the original erosion-streamflow project carried at the Great Basin Branch since 1912. The records of snow melting, surface run-off, silt measurements, vegetation succession, plant development, soil moisture, grazing utilization and climatological observations for the installations at Areas A-B were maintained for the 1933 season from May 5 to October 20. The accumulated records for this subproject from 1930 to 1933 inclusive now await analysis as to recent developments.

Future plans of this study contemplate reversing the methods of grazing treatment followed during the period from 1915-1933. Area "A" will be maintained as a control and Area "B" grazed for periods of time comparable to the periods of varied grazing treatment formerly used on Area A. This should counteract the influence of inherent differences in topography between the two areas and substantiate the conclusions which have been reached to date in the study. A thorough physical inventory of present conditions on the two areas will be made before the reverse method of treatment is inaugurated. This will include reconnaissance by transect sample plots, a soil survey, and remapping of soil profiles on the established permanent sample erosion plots.

Two surface run-off and erosion study installations, one in grass-weed type in the aspen-fir zone and one in a sagebrush-snowberry type in the oak zone, are planned. Each installation will consist of three one-tenth acre plots located where closely comparable conditions of cover, soil and topography obtain. The rate and amount of surface run-off and silt deposition will be recorded by suitable measuring devices for a period of three years to secure correlation data, after which one plot will be denuded by overgrazing, one moderately grazed, and one protected from grazing. Comparison of surface run-off and silt deposition under these conditions will be secured for an indefinite period of years. An additional plot, to be denuded by burning, is planned at the oak-zone location.

Subproject 2: A study of recent flood and accelerated erosion areas in Utah.

This line of work was largely completed and a manuscript report prepared in 1932-33. During 1933 four additional areas where floods were reported were examined as follows:

1. Six Mile drainage, San Pete County, Manti N. F.
2. Ephraim Creek, San Pete County, Manti N. F.
3. South Hughes Creek, Carbon County, Manti N. F.
4. Chalk Creek and adjacent area, near Fillmore, Millard County, partly in Fishlake N. F.

In all four cases grazing overuse has been a material factor responsible for cover conditions which set the stage for flood occurrence when heavy rainfall occurred. In two cases

(Six Mile and Chalk Creek) natural factors unfavorable to the growth of an adequate plant cover were involved. The occurrence of these floods in part from lands under grazing regulation within national forests, raises question as to the adequacy of present grazing practices in bringing about rehabilitation of overgrazed ranges to a sufficient degree of protective influence.

A report covering the erosion situation in Middle and Settlement Creek drainages in Tooele County, was submitted to the County Agricultural Agent, recommending the inauguration of a program of acquisition and management of watershed lands as the most practical and economical solution of the erosion problem there.

Future work on this study will be confined to examination of areas where further floods occur, or where advice as to erosion control and flood prevention measures is requested. Continued efforts will be made, during travel throughout the state, to secure information as to past flood history of the state.

Subproject 5: A survey of erosion conditions in the Upper Basin of the Colorado River watershed.

Progress was made toward completion of the final report of this survey, a preliminary report having been submitted. The search for information on early day erosion conditions for comparison with those of the present time necessitated the review of all available historical accounts of early explorations of the region. These include the official reports of exploratory surveys made under the direction of the War and Interior Departments, Smithsonian Institution

and Geological Survey, by such men as Powell, Hayden, Dutton, Gunnison, Beckwith and Ives and the journals of Captain Bonneville and Captain Fremont.

The final report of the survey proper will be completed shortly. No further work is contemplated for 1934 in this drainage.

Subproject No. 4: Miscellaneous

The study of erosion conditions in the upper basin of the Colorado River watersheds, and of recent floods and accelerated erosion in Utah has resulted in the accumulation of valuable information on various phases of the erosion-streamflow problem that should be brought into published form at an early date. Much of this information pertains to geologic relationships which have been observed by Reed Bailey during his connection with the project. One of these involves the geologic relationships in the problem of accelerated erosion and floods. Another refers to epicycles of erosion as recorded in the valley fills of southwestern Utah which supplies information on the occurrence of periods of accelerated erosion prior to settlement of the region. The origin and dynamics of mud flows such as occur in Utah have never been fully and adequately described. A good many observations have been made on physiographic evidence of accelerated erosion which could be compiled for use as a guide in observing accelerated erosion on range lands. The shore lines of old Lake Bonneville afford an opportunity for the analysis of normal and accelerated erosion since Lake Bonneville

disappeared. It is planned to complete manuscripts on these this year.

Plans for new work

The availability of Nira funds and the erosion control work being done by the CCC affords an opportunity for the completion this year of some important investigations on erosion control which will be of direct benefit in the conduct of Emergency Conservation Work. It also affords an opportunity for the completion of some erosion study installations for obtaining basic information in erosion control.

The short period investigations which can be completed this year are as follows:

1. Much of the erosion control work done by the CCC on various mountain watersheds in the State of Utah last summer, had to be done without established precedent, and the plans were developed as the work proceeded. Effort was made in every case to plan the control work so that comparative data could be secured. It is planned, therefore, to examine critically these areas to evaluate the different structures and systems used and to collect comparative data for the purpose of developing basic principles to be followed in future erosion control work. This includes the catchment basin type of work as well as structures and planting to control erosion and check flash run-offs at the headwaters of mountain streams.

2. If time is available, an economic survey will be made to ascertain the practicability from the cost standpoint, of doing erosion and flood control work of various types.

3. The availability of a flood control camp in Davis County affords the opportunity for further practical tests of erosion control methods on the watershed lands. The plan is to select a number of small drainages or segments of a watershed and apply a different method of control to each segment.

Phases 1, 2, and 3 as outlined above, will be done largely as a part of regular ECW camp work.

4. A study of the details of plant cover, soil, litter, slope and other factors contributing to the excessive run-off and erosion on the Davis County watersheds has never been made. A critical study of these details would afford information of value in both erosion control and restoration of plant cover on depleted watersheds. It is planned, therefore, to make a detailed erosion and plant survey of several of the watersheds in Davis County so as to be able to correlate erosion with the type and density of vegetation, plant, litter and soil on different degrees and aspects of slope. This will be a survey somewhat like the Boise erosion survey but with the improvements in technique which the Boise erosion survey showed to be needed.

5. Installations to study methods of erosion control - It is planned, providing some form of public ownership of the necessary

privately owned lands can be obtained, to establish a center of work (or branch station) on the badly denuded and eroded watershed lands in Davis County, Utah for the purpose of studying experimentally various systems of erosion control on steep mountain watersheds having granite-quartzite schist soils and brush cover types. Briefly, it is proposed that, (1) a number of plots comparable as to size and area, be selected representative of each of the conditions as determined by the more important kinds of plant cover and soil on the watershed, (2) equip each plot with devices to measure material removed by erosion, (3) undertake various methods of erosion control, and/or restoration of cover on quadruplicate sets of plots, (4) accurately measure quantity and rate of precipitation. Such a study will determine the most effective erosion control methods, most effective kind of vegetation for erosion control and the time required for various kinds of cover to become effective for the several conditions studied. This plan omits the measurement of surficial run-off and aims to correlate erosion with rainfall only. Measurement of run-off is omitted because cost and maintenance of measuring devices is very expensive and because the chief aim of the study is to determine means of controlling erosion by natural revegetation, planting and control structures. It should supply practical information on a pressing problem, namely, what is the best and most effective method of checking erosion on denuded eroded mountain watershed lands.

PUBLICATIONS

Forest Management

Accepted for Publication

Connaughton, C. A. - Growth in virgin ponderosa pine stands in central Idaho. (Journal of Forestry.)

Manuscript Completed

Connaughton, C. A. - A study of factors causing lower timberline in central Idaho. (Journal article.)

Prospective Manuscripts for 1934

Mowat, E. L. - The application of permanent sample plot growth to cut-over land. (Journal of Forestry.)

_____ - Management plan and economic possibilities for the Idaho City working circle. (Station Report.)

Connaughton, C. A. and E. L. Mowat, - The influence of forest cover on accumulation and rate of melting of snow. (J.A.R.)

_____ - Fire damage in the ponderosa pine type. (Department circular.)

_____ - Private forestry practices modified by the economic depression. (Journal of Forestry.)

Range Management

Summer Range - (Great Basin Branch)

In course of completion

Griswold, Sylvia M. - The role of seed germination in plant succession. (J.A.R.)

Data being analyzed

..... - The influence of climate upon the seasonal growth and development of range forage plants in three vegetative zones.

..... - The effect of year to year variations in climate on the growth and development of important range plants in three climatic zones on the Wasatch Plateau of Utah.

..... - A study of the influence of different degrees, frequencies and season of grazing and harvesting on the yield of range forage. Technical report on result of eight years of study.

McCarty, E. C. - Influence of season and frequency of grazing on carbohydrate metabolism of important range plants and its significance in range management. (Technical bulletin.)

Management, Sagebrush-Wheatgrass Range

Planned for completion, 1934

Craddock, G. W. - The influence of climate and grazing on sagebrush-wheatgrass range of the northern Snake River Plains in Idaho.

Stewart, George, and Pickford, G. D. - Conservative versus heavy grazing on sagebrush-wheatgrass range of the northern Snake River Plains.

Stewart, George; Pickford, G. D. and Hutchings, S.S. - New research methods in estimating forage cover and mapping low shrubs.

_____ and Pickford, G. D. - The influence of controlled burning on sagebrush-wheatgrass ranges in southeastern Idaho.

Desert Shrub Range

Manuscripts scheduled

Stewart, George; Pickford, G. D., and S. S. Hutchings. - Influence of past grazing on present condition of public domain and other similar ranges. (Technical bulletin.)

Harris, Dr. J. Arthur (deceased); Stewart, George; Forsling, C. L. and Young, Vernon A. - Plant sap properties and their relation to environmental conditions and to forage value. (Technical bulletin.)

Stewart, George and Cottam, W. P. - Forage types and successional trends on desert shrub ranges in western Utah. (J.A.R.)

_____ and Hutchings, S. S. - Relative quantity and quality of forage produced on different desert shrub associations. (J.A.R.)

_____ and Pickford, G. D. - A rapid and accurate method of mapping shrub vegetation. (J.A.R.)

Erosion-Streamflow Investigations

Bunchgrass-Granitic Soils, Idaho

Craddock, Geo. W., and Pearse, Kenneth. - Influence of plant cover, intensity of rainfall, degree of slope, and trampling on surface run-off and erosion as determined on small plots with artificial "rainfall" equipment. (Technical bulletin.)

Spence, Liter E. - Root systems of different plant species in relation to erosion control. (J.A.R.).

Craddock, Geo. W., and Pearse, Kenneth. - Progress in natural revegetation as a means of controlling erosion on depleted bunchgrass range. (J.A.R.)

Pearse, Kenneth - A preliminary ecological study of the vegetation on a portion of the Boise River watershed in relation to livestock grazing. (J.A.R.)

Stewart, George - Soil studies from Boise and Sawtooth Forests, Idaho.

Great Basin Erosion

In hands of printer

Bailey, R. W., Forsling, C. L., and Becraft, R. J., - Floods and accelerated erosion in northern Utah. (USDA Circular.)

Manuscripts in rough draft

Deming, Milo H. - The erosion situation on the upper basin of the Colorado River watershed. (Technical bulletin)

Manuscripts scheduled for 1934

Bailey, Reed W. - Geologic factors and relationships in the problem of accelerated erosion and floods. (J.A.R.)

_____ - How mud-flows originate. (J.A.R.)

_____ - Epicycles of erosion as recorded in the valleys of southeastern Utah. (J.A.R.)

_____ - Physiographic evidence of accelerated erosion.

_____ - An analysis of post-Bonneville normal and accelerated erosion and deposition in Utah.

_____ and Johnson, Wallace M. Erosion control systems and structures on steep mountain watersheds. (Handbook.)

Bailey, Reed W. - The relation of character of plant cover, soil and litter to the quantity and kind of erosion on Davis County watersheds. (Technical paper.)

Articles published since last report

Forsling, C. L. - Maintaining forage production on the range. The National Wool Grower, May, 1934.

_____ - Erosion: A challenge to America. Utah Juniper, v. 5, 1934.

Becraft, R. J. - Plant cover in relation to floods and watershed protection. Utah Juniper, v. 5, 1934.

Bailey, Reed W. - Problems in control of erosion and floods in Utah. Utah Juniper, v. 5, 1934.

Craddock, Geo. W. - The erosion-streamflow and range situation on the Boise River watershed. Utah Juniper, v. 5, 1934.

PHYSICAL DEVELOPMENT OF STATION PLANT

Unprecedented progress was made in the development of the Station plant. The outstanding accomplishments were the establishment of the Boise Basin Experimental Forest in the ponderosa pine type in Idaho and the Desert Experimental Range in the desert shrub type in western Utah and the development of the four branch stations. The branch stations where most of the work is being concentrated now include the Boise Basin Branch near Idaho City, Idaho, the Great Basin Branch near Ephraim, Utah, the U.S. Sheep Experiment Station Branch near Dubois, Idaho and the Desert Range Branch fifty miles west of Milford, Utah. In addition it is expected during 1934 to establish a work center for erosion studies on the Davis County watershed near Ogden, and a plant variety center of work on the University of Utah campus. With the exception of additional cross fencing and water and road development on the Desert Range and several additional cottages and miscellaneous structures, the several branches are developed to a fair degree of utility.

BOISE BASIN BRANCH

Silvical investigations in the Intermountain Region are concentrated on an experimental forest of 5,332 acres established in 1933 in the heart of the ponderosa pine type on the Boise National Forest near Idaho City, Idaho. Approximately 2,378 acres of the experimental area supports an excellent stand of virgin ponderosa pine timber; 1,840 acres of ponderosa pine have been cut-over selectively by the Forest Service, and the remaining area is in inferior timber types and open grass land. The timber types on the forest are being organized into a sustained yield unit, and the non-forested land is being utilized for erosion and grazing studies.

The establishment of the experimental forest and the concentration of work and availability of E.C.W. help and Nira funds makes possible several physical improvements in order that suitable headquarters facilities be provided and that the forest be made accessible, as well as adequately protected. In this work the CCC, Nira and CWA organizations were used with the result that a complete headquarters unit of ten buildings, to be used as a joint silviculture and erosion station headquarters designated as the Boise Basin Branch of the Intermountain Station, was constructed, a road was built through the forest to a nearby lookout station, and considerable roadside, stream and stand improvement work done. A few additional buildings to provide housing facilities still are needed and will be constructed if additional emergency funds become available.

GREAT BASIN BRANCH

This is a joint Range and Erosion-streamflow establishment. Improvements constructed with aid of ECW and Mira include the erection of one additional cottage, a new mess-bunkhouse, an additional garage-storeroom, a power line, and relandscaping of the station grounds. All old buildings including those at the Alpine center of work and erosion installations were remodeled and/or maintained to a high standard. The water system for the station was enlarged. All experimental pasture and enclosure fences were rebuilt or fully maintained.

U.S. SHEEP EXPERIMENT STATION BRANCH

A modern 4-room cottage and a 2-car garage and storehouse were constructed at the U.S. Sheep Experiment Station. A small woodhouse is needed to complete housing facilities. Bids have been awarded for the construction of 34 miles of woven wire fence to enclose and make available for range investigations the entire sheep station range. The Bureau of Animal Industry fenced four new 80-acre paddocks which now makes available a total of 18 paddocks for range research at the Sheep Station.

DESERT RANGE BRANCH

By Presidential proclamation dated February 1, 1933, 55,000 acres of winter range land in western Millard County was set aside for experimental purposes. This was designated the Desert Range Branch Experiment Station.

The most important activity on this area during the year was the construction of the project headquarters. Much of this work was carried on during the summer and fall by a CCC camp which was withdrawn about November 1. Thereafter the work was continued under the Nira program. The following items of construction are scheduled for completion by the end of 1934 as follows: Two dwellings, one messhouse and bunkhouse, office, one deep well together with a 40,000 gallon reinforced concrete reservoir, one barn, one warehouse, two 2-car garages, water system for headquarters, one electric plant and sixty miles of woven and barbed wire boundary fence.

The fencing of the area constituted the largest single item of activity. More than 24,000 native juniper posts were cut and hauled 60 to 100 miles. The establishment of headquarters will greatly facilitate experimental work since it forms an operating base which permits performing more elaborate and detailed experiments with greater care and closer supervision.

Approximately 30 miles of cross fence, experimental enclosures, additional water development including another well, and truck trail development still remain to be constructed. A CCC camp may be available for this work during the winter of 1934-35.

EROSION-STREAMFLOW CENTERS OF WORK

Two erosion-streamflow centers of work are in progress of development. One of them is on the Boise Basin Experimental Forest and involves installations to measure the influence of plant cover and grazing on erosion and run-off on two or three small watersheds,

other miscellaneous installations, and a few small buildings for the convenience of the work.

It is proposed to establish a center of work on the Davis County watershed involving installations to study control of erosion and a few minor buildings for the convenience of the work. Probably Davis County will buy the necessary land for this work. If this deal is not consummated, it will be necessary to make selection of another site.

UNIVERSITY OF UTAH GREENHOUSE

This will be discussed in separate correspondence.

SUMMARY OF

FOREST MANAGEMENT

PROJECTS

RS - INT
Mc - Ponderosa Pine

June 6, 1934

Project: Methods of cutting and natural reproduction of ponderosa pine.

Character and Scope: To determine the most satisfactory regional policy of cutting ponderosa pine as a reliable basis for management from a multiple use standpoint. To secure this result, information must be obtained on cutting methods, growth of residual and virgin stands; growth and mortality by tree and crown class; utilization, logging damage and brush disposal; the amount and trends of advance reproduction; and the germination, growth and survival of subsequent reproduction.

Progress Made: A seventeen year old record on 75 acres of virgin stand plots and an eighteen year old record on 20 acres of cut-over plots have been analyzed and reported. Two permanent 5-acre plots on a private cutting area were established in 1932. A 5,332 acre experimental area on the Boise National Forest was established in 1933.

The net annual growth over a period of 17 years in a virgin stand was found to be 140 bd. ft. or 25.3 cu. ft. per acre.

Old cut-over plot data are being combined with cut-over cruise data obtained from a 5 percent estimate of 3000 acres on various national forests and private cutting areas.

The experimental forest has been surveyed and partially cruised and mapped.

Seven permanent 10-acre plots were established on the experimental forest to study distinctive methods of cutting, reproduction, logging damage and slash disposal.

Plans: Analysis of cut-over plots and cruises will be completed and reported. Reproduction transects on method of cutting plots will be re-examined accompanied by other routine plot and experimental forest work.

Assignment: C. A. Connaughton and E. L. Mowat.

Probable date of completion: Indefinite.

RS - INT
Mc - Ponderosa Pine
(Plant Succession and Reproduction) June 8, 1934

Subproject: Natural reproduction as affected by associated vegetation and related factors in the central Idaho ponderosa pine type.

Character and Scope: To determine the influence of the lesser vegetation on the germination, survival and growth of natural reproduction in both virgin and cut-over stands.

Progress Made: A preliminary summarization has been submitted covering one year's work along lines presented in the previous annual report. The general scarcity of subsequent reproduction was emphasized. Survival was found to be definitely better on the north and west sides of trees, indicating that competition for soil moisture is a more important survival factor than light. Edges of burned slash piles and skid trails also offered favorable conditions for survival. Seedlings were least abundant where the lesser vegetation had not been disturbed and the litter was thin or absent.

Plans: Due to certain exigencies it has been necessary to terminate further cooperation on this project. The study offers a fertile field for further investigation, particularly along lines of advance reproduction. A final report should be prepared by January 1, 1935.

Cooperation: University of Idaho.

Assignment: Floyd Otter (Collaborator (Instructor, School of Forestry, University of Idaho)

Date of Completion: 1934.

RS - INT
Mc
(Snow Storage and Recession) June 8, 1934

Subproject: The effect of varying density and character of forest cover as may result from different methods of cutting ponderosa pine on the accumulation and rate of melting of the winter snows.

Character and Scope: To determine the effect of different densities and kinds of crown and ground cover in the ponderosa pine stands of central Idaho, upon the amount, water content and rate of melting of the total accumulated winter snowfall.

Progress Made: The project was initiated in the spring of 1930 as a result of serious objection raised by irrigators to the prevailing methods of cutting with regard to its effect on streamflow. The following crown and ground covers are represented: a typical over-mature, clean-floored ponderosa pine stand, an overmature ponderosa pine stand with a dense understory of 30-year old reproductions, a stand of 30-year reproduction, a dense stand of sagebrush, and bare ground. A three year record has been obtained on these plots and the project is to be closed in 1934.

A summary of the first progress report was published in 1933. Briefly it states that in a general way both winter snow storage and rate of spring melting are inversely proportional to the density and height of the crown cover. The 1933 field work confirmed the conclusions drawn from the data of the two previous seasons.

Plans: A final compilation of data and report are contemplated for 1934.

Assignment: C.A. Connaughton and E.L. Howat.

Date of Completion: 1934.

RS - INT
Pf - Damage

June 8, 1934

Subproject: Fire damage in the ponderosa pine type in central Idaho.

Character and Scope: To determine losses in timber, forage and watershed values caused by fire in the ponderosa type as a basis for more accurate and comprehensive appraisals of fire damage, including both those losses which are immediately apparent and those which are indirect or delayed.

Progress Made: The original field work on this project was done in 1932 on the Boise Basin burn. The survey included 5,120 acres of virgin timber and 5,330 acres of private cut-over land, sampling of all types of stands and sites represented within the fire. Ten semi-permanent sample plots and 126 chains of transects were established to determine subsequent losses, and reproduction and vegetative changes. The cruise data have been punch-carded and are now being analyzed. The sample plots and transects were re-examined in 1933.

The results of the cruise show that 60 percent of the merchantable volume of the cut-over stand and 62 percent of the merchantable volume of the virgin stand was destroyed by the fire. Approximately 10 percent of the volume of each was in doubtful trees thus leaving only about 30 percent of each stand in full vigor. On the basis of the stocked quadrat method, the stocking was reduced from approximately 60 percent of full stocking to only 9 percent in both stands, indicating the poor distribution of the surviving trees. An average of 86 percent of all reproduction was destroyed. Erosion was found to vary almost directly with the intensity of the burn and percent of slope.

Plans: A report summarizing the results of the fire damage cruise will be prepared in 1934. Semi-permanent plots and transects will be examined annually until noticeable degradation processes resulting from the fire are at an end. The plots may be remeasured every five years to determine long time losses and changes.

Assignment: C. A. Connaughton and E. L. Mowat.

Date of Completion: 1934, except for recurrent observations.

RS - INT
Me - Ponderosa Pine
Growth, Evenaged Stands

June 9, 1934

Subproject: Yield of evenaged stands of ponderosa pine.

Character and Scope: To construct normal yield tables for ponderosa pine which will be applicable insofar as possible, to the entire range of the species. Includes Regions 1, 2, 3, 4, 5 and 6, each providing field measurements of temporary sample plots taken in fully stocked, evenaged, pure stands.

Progress Made: New project for Intermountain region. Initiated in 1928 by the Pacific Northwest Forest Experiment Station, expanded to interregional study in 1932. Prospective stands in Region 4 were examined in September 1932.

Plans: A minimum of 50 temporary plots will be measured in 1934, sampling all ages and sites which can be found. All of the field work will be done in central Idaho.

Assignment: E. L. Mowat, under direction of W. H. Meyer of the Pacific Northwest Forest Experiment Station, which station will handle compilation of all data.

Date of Completion: 1934.

SUMMARY OF

RANGE MANAGEMENT

PROJECTS

RR - INT
Management
Summer Range (Wasatch Plateau)

June 9, 1934

Project: The development of methods of range management on high mountain summer range lands to insure the maintenance and improvement of the grazing capacity of the native forage crop in the manner best to meet the requirements of the range itself, of the dependent livestock, and of the related forest land resources.

Character and Scope: This broad project logically breaks down into a number of subprojects or phases, of which the following are under study at the present time.

1. The effect of climate on plant growth.

2. Natural revegetation as a means of improvement and maintenance of the range.

3. The degree of utilization as a factor in range management.

4. The influence of season, frequency and degree of harvesting on the productivity, revegetation and vigor of range vegetation.

RR - INT
Management
Summer Range (Wasatch Plateau)
(Climate and Plant Growth)

June 9, 1934

Subproject: The effect of climate on plant growth.

Character and Scope: To determine for mountain summer range (1) which of the more common climatic factors are of primary importance to forage growth, and (2) the part climate, and particularly the fluctuations in climate from year to year, play in (a) forage development and production, (b) the outcome of experimental work generally, and (3) the adjustments in range management necessary to meet fluctuations in forage production.

Progress made: Records of the more important climatic factors have been keep during the main growing season continuously since 1914, and in some instances yearlong, in three vegetative (altitudinal) zones on the Wasatch Plateau in Utah. Forage yield and time and rate of growth have been observed since 1924 to correlate plant growth and forage yield with the climatic factors.

Vicissitudes of climate as they affect both the time and length of grazing season and the quantity of forage produced have long been recognized to play an important role in range management and forage production. Nevertheless, other exigencies have lead to practices of making both range management and livestock handling conform more or less to set calendars of operation. Results to date in this study by measuring the extent of these fluctuations and their influence on time, rate and quantity of forage production show that variations in climate are so wide as to appear to justify certain elasticity in range management plans or some other provisions to meet them. Total forage production for a season, for example, may vary from as much as 40 percent above the average in one year to 40 percent below the average in another year. Also the time when grazing should begin may vary as much as 30 days earlier in one year as compared to other years.

Plans: The project will be continued along the line of developing facts and information upon which to base range use that will more adequately meet this problem of climatic vicissitudes from the standpoint of the needs both of management of the range and the needs of livestock. Any study involving climate necessarily must be on a long time basis because of the naturally wide variety of conditions to be met. Climatic records also perforce must be continued in order to be able to weigh the influence of climate in the outcome of other experimental studies.

Assignment: C. L. Forsling, Raymond Price

Date of Completion: Indefinite.

RR - INT
Management
Summer Range (Wasatch Plateau) June 9, 1934

Subproject: Vegetational readiness and the length of the grazing season on summer range.

Character and Scope: To determine the effect of continued early use on the vigor and production of range forage plants, (2) the time at which livestock may be admitted to the range without injury to the forage from too early use, (3) methods of determining the time of range readiness, (4) the effect of close cropping of the vegetation in the fall after seed maturity, and (5) the time that grazing should be discontinued in the fall.

Progress made: The results obtained prior to 1923 were published in Department Bulletin 1405.

A systematic study has been made from 1925 to 1932 of the important range plants at varying elevations to determine the variation in vegetational development (phenology) from year to year. Detailed growth records of individual plants of important forage species have been obtained from the start of growth in the early spring and continuing throughout the season until covered with snow in the fall.

Plant development and growth records were obtained throughout the season for a few key stations only. Progress was made in the final compilation and analysis of field data during the F.Y. 1934.

Plans: Field work has been discontinued in this project. Observations will be maintained as a part of the climate and plant growth project. Analysis of data and preparation of a report will be pushed during the F.Y. 1934.

Assignment:

Date of completion: 1935.

RR - INT
Management
Summer Range (Wasatch Plateau) June 9, 1934

Subproject: Range improvement and maintenance by natural revegetation of native forage species on summer range lands.

Character and Scope: To determine (1) the most expedient and economical method of natural revegetation of native forage plants, (2) the rate of reestablishment of valuable forage plants on depleted range lands, (3) the role of seed production and germination as a factor in the natural revegetation of range lands, and (4) methods of management of livestock on the range to meet the requirements of the native forage plants for natural revegetation and at the same time meet the feed requirements of the livestock to the fullest degree possible.

Progress made: Seventy six quadrats, 71 major plots, and 7 intensively mapped areas have been established since 1914 in the three major vegetational zones on the Wasatch Plateau in central Utah. These plots have been remapped and rechecked at definite intervals to determine the change of the native forage cover on range lands varying in degrees of depletion, erosion and intensity of grazing. Results to 1922 have been published in Departmental Bulletins 791 and 1405.

Seeding habits, seed production, seed dissemination and germination under various conditions of storage, temperature, and moisture relationships for 55 important range species have been determined for four seasons.

Three 40' x 40' rodent proofed enclosures with accompanying quadrats and major plots were established in 1931 to obtain information on the role of rodent in natural revegetation.

All of the data obtained up to and including 1933 have been compiled and analysis started.

Plans: The plots not mapped in 1933 will be mapped in accordance with the regular schedule. These plots will be continued for an indefinite period. Compilation will be undertaken with a view of preparing an additional progress report. The report on the study of seed production and seed germination is nearing completion.

Assignment: R. Price, S. Griswold.

RR - INT
Management
Summer Range (Wasatch Plateau)
(Degree of Utilization)

June 9, 1934

Subproject: The proper degree of utilization of important range plants.

Character and Scope: To determine (1) proper degree of utilization, (2) standards for judging utilization, and (3) percentage of good forage which should remain at time of seed maturity each year on ranges where deferred and rotation grazing is not applied to improve or maintain the forage stand.

Progress made: A pasture was constructed on the high summer range lands of the Wasatch Plateau in 1923 and has been grazed by a small herd of cattle since 1925. Twelve hurdle plots 16' x 16', supplemented by 12 quadrats were placed in this pasture to secure varying degrees of utilization of the important range plants each year. Field work was discontinued in 1932 and this project is ready for final analysis. All data have been compiled and are awaiting analysis.

Plans: Analysis will be pushed with the view of making a final report of the project. The pasture will be held in reserve for future studies, particularly studies to show carbohydrate relationships.

Assignment: R. Price.

Date of Completion: 1934.

RR - INT
Management
Summer Range (Wasatch Plateau)
(Season, Frequency and Degree of Harvesting)

June 9, 1934

Subproject: The relation of season, frequency and degree of harvesting to the productivity, revegetation and vigor of the vegetation.

Character and Scope: To determine the effect of vigor, revegetation and productivity and carbohydrate accumulation of harvesting at different seasons, intervals, and closeness of cropping on important forage species growing on mountain summer range and to work out methods of grazing based on the results to improve and maintain the range, and at the same time obtain the best use of the forage.

Progress made: The main results of early work, involving 11 species and 20 methods of harvesting, are reported on in Department Bulletin 1405. The project was revised in 1923 to study more critically some of the methods previously tried out, on a plot rather than individual plant basis, supplemented with actual grazing trials. The clipping and grazing field work, except for the browse species, is completed and is being analyzed. Two important browse species were added to the clipping study in 1926 and were supplemented with hurdle plots.

Preliminary field work on the carbohydrate study was initiated in 1931 at which time plots were established and made ready for actual work during 1932. Two years' work of the proposed 4-year project is now completed.

The analysis of the empirical clipping methods has not progressed far enough to draw any final conclusions.

The carbohydrate study to date indicates a declining quantity of food storage at the end of the season as foliage removal approaches the stage of seed maturity. However, grazing when deferred until seed maturity showed small adverse effect on plant food storage, evidently due to the gradual removal of foliage over a period after seed maturity as compared to complete removal on a single date as in the case of the clipped specimens. Observations show that growth activities and draught on stored carbohydrates begins in the spring several weeks before snow is melted, even under several feet of snow.

Plans: To continue the analysis of all available data in the empirical phase and to continue the carbohydrate study. Reports should be completed on all four phases during 1934.

Assignment: R. Price. (Carbohydrate study in cooperation with Dr. E. C. McCarty of Riverside College.) D. I. Rasmussen. A. J. Lindsey.

Probable date of completion: 1934, except carbohydrate study in 1935.

RR - INT
Management
Sagebrush-Wheatgrass

June 8, 1934

Project: The management of sagebrush-wheatgrass range.

Character and Scope: To determine methods of range management which will improve and maintain native forage crop on sagebrush-wheatgrass range and at the same time develop its best use for range sheep and cattle production.

The sagebrush-wheatgrass ranges of the region are in heavy demand for spring and fall grazing, and for the most part are far below potential productivity as the result of injudicious use in the past. They are "key" lands to range livestock production and improved methods of management are required to insure economical operation.

Progress Made: Range management studies were started at the U.S. Sheep Experiment Station in 1923 in cooperation with the Bureau of Animal Industry. Until 1933 study was made of the influence of yearly climate on forage growth and production and on sheep production; the influence of four systems of grazing (1) yearly deferred, (2) continuous spring, (3) summer, and (4) fall grazing on range productivity; and carrying capacity on herded range. In 1933 Systems 2 and 3 above were replaced by two rotational spring grazing systems to determine the best and most efficient method of range management to rebuild depleted range.

A tentative draft of a manuscript covering nine years results in this phase of the study is being prepared. Due to a prolonged drought, vegetation on quadrats protected ten years from grazing show only a fractional percent of improvement.

To determine the extent of these changes, their influence upon the grazing capacity of the range, the potential productivity and stages of plant succession and how much time is required for natural rehabilitation of this type of range, is an essential basic step in developing suitable methods of range management. A study of the effects of fire and past use on vegetation was carried on through 1930 and published in 1932. In 1932 basic data were taken on eight typical areas which had been selected and fenced against grazing use in 1931 for future reference as natural areas. An area on state-owned land north of St. Anthony, was selected in 1932 to be burned in order to make a study of the effects of fire on shrub and herbaceous cover. Basic data were obtained in 1932.

The present forage value of Public Domain sagebrush-wheatgrass ranges in the Intermountain Region has declined 56 to 79 percent in grazing capacity due to past injudicious use. Perennial grasses have declined 56 to 86 percent. The decrease of perennial grasses statistically

is shown to be responsible for 80 percent of the range deterioration.

Plans for 1934: To complete the report on the early stages of the study, to modify the experimental systems of grazing in eight paddocks and initiate similar systems in four new paddocks so as to determine methods of improving depleted range, a detailed plan of which is to be sent to the Branch of Research in Washington, D. C. for approval and to begin observation on the effect of burning sagebrush on the herbaceous vegetation on the St. Anthony area burned in 1933. A complete recheck of all plots installed and measured prior to burning is contemplated.

Cooperation: U.S. Sheep Experiment Station of the Bureau of Animal Industry.

Assignment: George Stewart, G. D. Pickford, (G. W. Craddock pending completion of manuscript, and J. M. Cooper of the U.S.S.E.S. Bureau of Animal Industry.

Date of Completion: Indefinite.

RR - INT
Management
Desert Shrub Range

June 8, 1934

Project: Management of desert shrub ranges.

Character and Scope: To determine, experimentally, the methods of management which will restore and maintain the growing productivity and promote the best use, of desert shrub ranges. This involves the character, distribution, forage value, growth requirements, and reaction to grazing of the native vegetation.

Progress Made: Preliminary investigations as a basis for more detailed study were started in 1930 and carried through 1934. These show that there has been a 58 percent decline in the grazing capacity of the desert shrub ranges in western Utah and central Nevada, many of the better forage species have failed to establish seedlings during the last 20 years and existing stands of more palatable species are being replaced by inferior forage plants. Sheep losses are excessive, especially during drought, and lamb crops also fall far below normal. To determine the extent of these changes, their influence upon the grazing capacity, what are the stages of plant succession, their relative importance as to forage production, and how much time is required for natural rehabilitation of these desert shrub ranges is an essential basic step in developing proper methods of range management.

During 1933 detailed range survey data were taken on the 55,000 acres included in the Desert Range Experimental area and 15,000 acres of similar adjacent public domain. These will serve as a bases for comparing all influence of future grazing. Soil and vegetative transects were made to determine present vegetative cover, trends in plant succession as influenced by grazing, soil, and climate and also to determine correlation between soil and type. Studies of methods of grazing management, vegetative plant development and palatability and nutritive value of desert vegetation were initiated.

The major part of the physical development of Desert Range Branch headquarters was completed.

Plans: Analyze and prepare manuscript for all complete projects. Concentrate experimental work at Desert Range Branch headquarters and develop experimental management of the range to study natural rehabilitation, influence of climate and plant growth, palatability and utilization, ecological factors affecting plant succession, and nutritive value of desert vegetation.

Assignment: George Stewart, Selar S. Hutchings.

RR - INT
Artificial Reseeding

June 9, 1934

Project: Artificial reseeding of depleted mountain summer range lands.

Character and Scope: To determine (1) suitable species, (2) site conditions, (3) methods and time of seeding, (4) seed production, (5) methods of grazing during periods of establishment, and (6) economics of improving depleted range by introduction of tame (cultivated) and native forage species on mountain ranges in central Utah where the annual precipitation is from 18 to 30 inches, and the growing season 100 to 120 days in length.

Progress made: Artificial reseeding trials have been undertaken since 1910 on thw Wasatch Plateau in Utah. These trials have been on a small scale and of an empirical nature. A large number of forage species have been tried out at different elevations under various soil conditions, moisture, time of seeding and treatment. The results of the work up to 1927 were published in 1931 in Department Circular 178.

Practically all of the artificial reseeding tests made since 1925 have been in the oak brush zone where the main growing season extends from May 1 to August 31. The sweet clovers, crested wheatgrass, common brome, slender wheatgrass and many-flowered brome were used in most of the tests. These tests involved various methods of tilling the land, covering the seed, and time of sowing.

Examinations of all former plantation and nursery tests show that practically all of the species sowed in the preceding year made very good growth and matured seed, particularly crested wheatgrass which made very excellent growth. However, rodents took practically all available seed produced. Seedlings were noted to be fairly numerous and in good vigor. Crested wheatgrass when moderately grazed continued to increase in density and shows exceptional prospects for range reseeding both in the oak and sagebrush range types.

Plans: Examinations of results from former sowings will be continued.

Cooperation: Bureau of Plant Industry on tests with sweet clovers, crested wheatgrass and common brome.

Assignment: R. Price (and L. W. Kephart of Bureau of Plant Industry).

Probable date of completion: Indefinite.

SUMMARY OF

EROSION-STREAMFLOW

PROJECTS

R - INT
Special
Erosion & Streamflow
Bunchgrass-Granitic Soils

June 9, 1934

Project: The influence of plant cover and its use in the bunchgrass type on granitic soils on erosion and streamflow.

Character and Scope: To determine, for watersheds of the bunchgrass type on loose granitic soils (1) the causes of erosion; (2) the rate of erosion; (3) the influence of herbaceous cover as affected by grazing use in controlling erosion and regulating run-off; and (4) methods of checking and controlling erosion and maintaining desirable run-off conditions by natural and artificial revegetation and other means. The problem involves the investigation of all the factors, especially those in which plant cover plays a part, that affect the yield and rate of discharge of water from a watershed and the erosion of the soil as a means of determining the amount, kind and regulation of cover that will obtain desirable streamflow and control erosion.

Progress made: 1. A range-erosion survey of more than 371,000 acres of typical watershed lands was completed in 1930 to isolate the various factors which contribute to erosion. A report is in preliminary manuscript form.

2. A series of profile plots have been established and resurveyed to measure the rate of gully and sheet erosion.

3. The management of the bunchgrass-granitic soil type of range of previous reports has been combined with this phase of the erosion-streamflow project. A number of studies have been initiated to investigate the static factors of site and soil-plant relationships, as a step toward determining the influence of herbaceous cover on run-off and erosion. Analysis of nearly 200 soil samples show that past erosion has materially reduced the moisture capacity, organic content, nitrogen content, and clays and silts of typical soils. A special study of root systems was initiated in 1932 to determine the soil binding value of different plant species. General observations are under way to compare the degree of erosion from melting snow and from summer rains.

4. Eleven areas, 0.1 to 200 acres in area, have been selected and fenced to exclude livestock; 100 5x5 meter major plots and 95 meter quadrats were established under different conditions of grazed and ungrazed range. From data obtained on these plots a preliminary description of the vegetation in relation to grazing and erosion has been prepared.

5. No specific studies have been started thus far to determine methods of checking and controlling erosion.

The 1933 field season was devoted largely to the study with a portable unit of apparatus of surficial run-off and erosion on temporary plots under controlled conditions of artificial rainfall.

Forty four satisfactory tests were completed with the portable "rain-making" outfit including trampled and untrampled areas on three plant types, and with two intensities of rainfall. These tests show the natural bunchgrass cover to be superior in preventing erosion than chessgrass or annual weed types, especially under the higher intensity of rainfall and on trampled range. Trampling with high intensities of rainfall increased erosion three-fold on the weed type, and 10-fold on the chessgrass type, but this treatment less than doubled erosion on the bunchgrass type, and 21 times more erosion occurred on the annual weed type and 19 times more on chessgrass as compared to bunchgrass.

Snow survey studies show a very high probability of correctly forecasting streamflow from snow survey data.

Additional rain gauges established will facilitate the study of influence of amount and distribution of rainfall on erosion.

Root studies show that the plants which come in on eroded areas are much inferior to the plants present in the original stand for binding the soil.

Recheck surveys indicated that, in three years, the only appreciable changes of several gully sections have occurred through the breaking down of steep banks. Changes on the sheet erosion plots were insignificant.

Preliminary analysis of data from 24 quadrats and 35 major plots which were recharted for correlation of plant growth with climate show that the original bunchgrass cover fluctuates less with variation in climate and maintains a better protective cover than the annuals and other species which invade overgrazed areas.

Plans: To measure with two sets of portable apparatus, surficial run-off and erosion as caused by applications of two different intensities of artificial rainfall on duplicate temporary plots representing different conditions of slope, cover and soil. To complete the root study and to continue study of plant succession and rate of erosion control by natural revegetation on areas protected from grazing, and to install apparatus and commence measurements on two small selected watersheds for the purpose of determining influence of grazing plant cover on surficial run-off, total water yield and soil erosion.

Assignment: Geo. W. Braddock, Jr., and Kenneth Pearse.

Date of completion: Indefinite.

R - INT
Special
Erosion & Streamflow
Great Basin

June 8, 1934

Project: A study of the influence of plant cover, as modified by grazing, on surficial run-off and erosion, on watershed lands in the Great Basin.

Plant cover is recognized to play an important part in the regulation of run-off and control of soil erosion on uncultivated lands. Modification by grazing or other cause, of the plant cover, will disturb the natural relationships which exist between cover and run-off and erosion of the soil. The evaluation of these relationships and determination of the influence of modification of the cover is necessary to the intelligent protection, management and use of watershed lands. The project is divided into 5 subprojects or lines of work as follows:

Subproject 1.

Character and Scope: To determine by careful measurement of cover, soil, slope, precipitation, run-off and erosion on two small typical high mountain watersheds, each approximately 10 acres in area, on the Wasatch Plateau of central Utah having limestone-clay-shale soil, (1) the role of herbaceous vegetation in the regulation of surficial run-off and control of erosion, (2) the regulation of grazing necessary to maintain adequate cover for watershed protection.

Progress made: Started in 1915 and continued up to date, with periodic alteration of grazing treatment on one area, the other being maintained as a control.

A preliminary study covering early work was published in USDA Bulletin No. 675. Results from 1915 to 1929 inclusive, were published in USDA Technical Bulletin No. 220. Since 1929 current observation records have been continued and filed, but have not yet been compiled or analyzed for any additional developments.

Plans: It is planned to reverse the treatment of the two experimental areas and modify the cover on the one formerly treated as the control area, and use the other as the control and so handle them for at least 5 years, for the purpose of determining the influence of inherent differences such as topography, in the two areas. Two series of tenth-acre plots, one in the high mountain weed type and one in the intermediate elevation sagebrush-snowberry type, will be established in 1934 more critically to measure surface run-off and erosion, under no grazing, moderate or proper grazing and heavy grazing, where it is possible more completely to control all of the factors involved than on larger sized areas.

Assignment: C. L. Forsling, Milo H. Deming, Herbert C. Fletcher.

Probable date of completion: Indefinite.

Subproject 2.

Character and Scope: A survey in Utah of recent floods and accelerated erosion areas to determine (1) the nature and extent of occurrence of abnormal floods and erosion, (2) the causes contributory to such floods and erosion, (3) the possible and practical measures of control and prevention, (4) the advisability of further research for solution of the watershed protection problem in Utah.

Progress made: Findings on 25 important flood areas were incorporated in "Report of Utah Flood Survey, 1931-32" submitted to the Utah State Land Board. This report has not yet been published, but the information obtained was indispensable to locating camps and planning work of the CCC.

Observations on four additional areas on which floods occurred during 1933 confirmed conclusions from the earlier studies, that depletion of plant cover has greatly increased flood damages and has accelerated erosion in many places in Utah. The 1933 floods occurred as a result of heavy local summer rainstorms where plant cover was insufficient to prevent gathering of surface run-off in flood proportions. On all four overgrazing had reduced the plant cover, although in two cases natural conditions unfavorable to production of a heavy plant cover were partially responsible. Two of the areas are wholly and two partly within national forests. It would appear that under present grazing practices some formerly overgrazed lands have not as yet reached a stage of recovery sufficient to prevent excessive surface run-off at times of heavy storm.

Plans for future work: Fieldwork is largely completed. The general report may be incorporated into a publication. It is planned in addition to prepare reports for publication on the origin and dynamics of mudflows, characteristics of flash floods in Utah as a guide in observing a ccelerated erosion on range lands, and an analysis of normal and accelerated erosion as indicated by shore lines of annient Lake Bonneville.

The flood and erosion situation on watersheds in Davis County, Utah affords opportunity to obtain more detailed information on plant cover, soil, litter, slope, and other factors contributing to excessive run-off and erosion. A critical study of these details is planned for 1934 which it is expected will afford information of value in both erosion control and restoration of plant cover on depleted watersheds.

Assignment: Milo H. Deming; Reed W. Bailey.

Date of Completion: 1934

Subproject 3.

Character and Scope: An extensive survey in the Upper Basin of the Colorado River for the purpose of securing definite information as to the extent and character of accelerated erosion, the apparent contributing factors and effect of this erosion on silt load of streams, depletion of range values, and other economic phases of human occupancy and resource development of the Colorado River basin, and to determine the phases of the problem and prior need of detailed or localized research as to causes and the possible means of control and prevention of erosion.

Progress made: A field examination was started in 1931. It was completed in 1933 after numerous observations previously made by various workers in the investigation of the natural resources of the region. A preliminary report has been submitted. A more detailed report covering the complete findings of the project is nearing completion.

The generally prevailing conditions of climate, soil and topography, and plant cover are such as to be naturally conducive to a high normal rate of erosion in the Upper Basin of the Colorado River. However, the most recent epicycles of erosional activity is largely coincidental with the time of settlement of the region and since that time the rate of erosion has apparently been very materially accelerated. It is estimated that erosion is accelerated on 50 percent of the watershed, is moderate on 27 percent, and light on 23 percent. Areas of greatest accelerated erosion are at medium and lower elevations, where the climate is adverse to establishment of abundant plant cover and where the soil is naturally highly susceptible to erosion. However, it is apparent that the normal rate of erosion has been greatly accelerated by depletion of plant cover due to extreme grazing.

Plans for future work: To complete the general report of the survey and to analyse results and prepare reports obtained in connection with the survey pertaining to geological relationships in accelerated erosion and epicycles of erosion as recorded in the valley fills of southwestern Utah.

Assignment: Milo H. Deming and Reed W. Bailey.

Probable date of completion: 1934.

Subproject 4 (new work)

Character and Scope: Basic principles to be followed in engineering work to control erosion and flash run-offs in the headwaters of mountain streams.

Plans: Much of the erosion control work done by the CCC in Utah last summer and again this year has had to be done without established precedent and the plans have been developed as the work proceeded. Work has been done so that comparative data could be secured. It is planned to examine critically the work done to date to evaluate the different structures and systems used for the purpose of developing the basic principles to be followed in the future. It is planned to incorporate the findings into a handbook.

Assignment: Reed W. Bailey.

Probable date of completion: 1934.

Subproject 5 (new work)

Character and Scope: Experimental aid to study systems of erosion control for application on steep mountain watersheds having granite-quartzite-schist soils. Up to the present, erosion control work has been planned largely on the basis of rule of thumb. A sounder basis is needed for developing practices to follow. It is planned to select a number of plots 1/10 to 1/5-acre in size on typical watershed land representing the more important kinds of plant cover and soil on the watershed, equip each plot with devises to measure material removed by erosion, undertake various methods of erosion control and/or restoration of cover, on comparable plots and accurately to measure quantity and rate of precipitation, and quantity of erosion for each experimental setup for use as a basis in developing basically sound practices in erosion control.

Location: Davis County watershed, Utah.

Assignment: Milo H. Deming.

Probable date of completion: Indefinite.